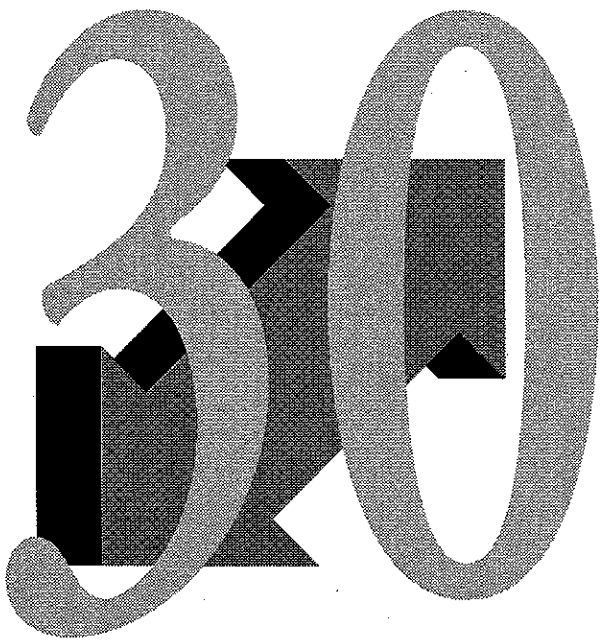
BiPAP® VENTILATORY SUPPORT SYSTEM

Models S/T 30 and S/T-D 30



Service Manual

BiPAP Systems are the subject of U.S. patents #5148802, #5239995, #5313937, #5433193, and other pending U.S. and foreign patents. BiPAP is a registered trademark of Respironics, Inc.

Part number 556052 4/2/97

© 1997 Respironics, Inc. All rights reserved.

Contents

Chapter 1: Warnings, Cautions, and Notes 1-1
1.1 Warnings 1-1
1.2 Cautions 1-2
1.3 Notes 1-3

Chapter 2: System Description 2-1
2.1 BiPAP 30 System Specifications 2-1
2.2 Functional Description 2-4
2.3 System Components 2-5
2.4 Unit Identification 2-7

Chapter 3: Controls and Setup 3-1
3.1 Description of Controls 3-1
3.2 BiPAP 30 System Configuration 3-7

Chapter 4: Maintenance 4-1
4.1Maintenance Schedule 4-1
4.2 Maintenance Procedures 4-3
4.2.1 Recording the Hours on the Time Meter 4-3
4.2.2 Verifying the Voltage Selector Switch Setting 4-3
4.2.3 Changing the Fuses 4-3
4.2.4 Test Control Functions 4-3
4.2.5 Notes to Maintenance Procedures 4-4
4.2.6 Cleaning the BiPAP 30 Unit 4-4
4.2.7 Changing the Filter 4-5

Chapter 5: Troubleshooting 5-1
5.1 Troubleshooting 5-1
5.1.1 Troubleshooting Chart 5-2
5.1.2 Power Switch Wiring 5-7
5.1.3 Motor Control Board (MCB) Checks 5-7
5.1.4 Transformer Checks 5-8
5.1.5 Valve Checks 5-9
5.1.6 BiPAP 30 Control Board (BCB) Checks 5-10
5.1.7 Blower Pressure Check 5-10
5.2 Wiring Diagram 5-11

Chapter 6: Replacement Instructions 6-1
6.1 Repair Information 6-1
6.2 Replacement Instructions 6-2
6.2.1 Preparing the Unit for Service 6-2
6.2.2 Replacing the BiPAP 30 Wraparound 6-4
6.2.3 Replacing the BiPAP 30 Flow Pickup Tubes 6-5
6.2.4 Replacing the BiPAP S/T-D 30 or S/T 30 Front End Cap 6-6
6.2.5 Replacing the BiPAP 30 Blower Module 6-10
6.2.6 Replacing the BiPAP 30 Muffler (Serial Numbers <100742) 6-16
6.2.7 Replacing the BiPAP 30 Muffler (Serial Numbers >100742) 6-20
6.2.8 Replacing the BiPAP 30 Valve 6-24
6.2.9 Replacing the BiPAP 30 Motor Control Board (MCB) 6-30
6.2.10 Replacing the BiPAP S/T 30 or S/T-D 30 Control Board 6-32
6.2.11 Replacing the BiPAP 30 Time Meter 6-38
6.2.12 Replacing the BiPAP 30 AC Inlet Connector 6-40
6.2.13 Replacing the BiPAP 30 Voltage Selector Switch 6-42
6.2.14 Replacing the BiPAP 30 Transformer 6-46
6.2.15 Replacing the Trigger Board 6-50
6.2.16 Replacing the Power Switch 6-54
6.2.17 Replacing the Pressure Port (S/T-D Only) 6-56
6.2.18 Replacing the Transformer Secondary Fuses 6-60

Chapter 7: System Test 7-1
7.1 Requirements 7-1
7.1.1 Equipment 7-1
7.1.2 Data Sheet 7-1
7.1.3 Test Sequence 7-1
7.2 BiPAP Set Up 7-2
7.3 Initial Equipment Setup 7-3
7.4 System Adjustment 7-4
7.4.1 Motor Speed Adjustment 7-4
7.4.2 Flow Transducer Adjustment 7-6
7.4.3 Valve Control Adjustment 7-7
7.4.4 Pressure vs. Flow Adjustment 7-8
7.4.5 Pressure Monitor Adjustment (S/T-D units only) 7-9
7.4.6 Blocked and Unblocked Watts 7-10
7.4.7 Trigger Level 7-11
7.5 Run-In Test 7-12
7.6 System Final 7-13
7.6.1 Verify System Adjustment 7-13
7.6.2 Equipment Setup 7-13
7.6.3 Spontaneous Mode Verification 7-14
7.6.4 Spontaneous/Timed Mode Verification 7-16
7.6.5 Timed Mode Verification 7-18
7.6.6 DCP Verification (S/T-D 30 only) 7-20
7.7 Corrective Actions 7-21

Chapter 8: Repair Part List and Exploded Views 8-1

Appendix A: Service Tools A-1
A.1 Service Tools A-1
A.2 Service Supplies A-2
A.3 Acceptable Electronic Test Equipment A-3
A.3.1 Flowmeter A-3
A.3.2 Oscilloscope A-3
A.3.3 Digital Manometer A-3
A.3.4 Wattmeter A-4
A.3.5 Frequency Counter A-4

Appendix B: Data Sheets B-1

Appendix C: BiPAP 30 Screening Procedure C-1

Appendix D: DC Operation
D.1 DC Operation D-1
D.2 Specifications D-2

Appendix E: BiPAP 30 System Schematics
E.1 Wiring Diagram E-1
E.2 Schematic Statement E-1

Chapter 1: Warnings, Cautions, and Notes

WARNING: Indicates the possibility of injury to the patient or the operator
CAUTION: Indicates the possibility of damage to the device
NOTE: Places emphasis on an operating characteristic

1.1 Warnings

General

- This manual serves as a technical reference only. Refer to the clinical manual for complete instructions concerning applications.

Safety

- The BiPAP 30 System is intended for use with a Respironics, Inc. approved patient circuit only. A Respironics approved circuit consists of :
    - a mainflow bacteria filter
    - a transparent proximal pressure line ($^1/_8$") with smooth inner lumen
    - patient circuit (22 mm ID) with smooth inner lumen
    - an exhalation device such as the Whisper Swivel®, Respironics Disposable Exhalation Port Assembly, or Plateau™ Exhalation Valve
    - a Respironics noninvasive patient interface (nasal mask, mouthpiece, or full face mask).
- The continuous flow exhalation port (e.g., Whisper Swivel) is designed to exhaust CO_2 from the patient circuit. Continuous flow is required for safe operation. DO NOT BLOCK OR OTHERWISE TRY TO SEAL THE GAS VENTS ON THE EXHALATION PORT.
- To reduce the risk of contamination, a low-resistance main flow bacteria filter must be placed in-line between the unit and the patient.
- When the BiPAP S/T-D 30 System is used with the Detachable Control Panel (DCP 30), the DCP 30 settings override the settings on the BiPAP S/T-D 30 System's control panel. Adjust the DCP 30 settings appropriately before setting up the patient on the BiPAP 30 System circuit. DO NOT connect the DCP 30 to the BiPAP 30 System while the unit is turned on.
- Explosion hazard—do not use the BiPAP 30 System in the presence of flammable anesthetics.
- Oxygen supports combustion. Oxygen should not be used while smoking or in the presence of an open flame.
- DO NOT add oxygen to the front inlet filter opening of the BiPAP 30 unit (at the inlet filter opening).

Warnings *continued*

Operation

- When the BiPAP 30 System is used with a heated humidifier, that manufacturer's specifications should be checked to confirm that the humidifier will function correctly in the presence of the continuous flow from the BiPAP 30 System. Always position the humidifier lower than both the BiPAP 30 unit and the patient.

- Never attach oxygen tubing or any positive pressure source to the pressure port on the front panel of the BiPAP S/T-D 30 unit.

Service

- Wiring connections and adjustments should be performed by authorized service personnel ONLY.

- Repairs and adjustments MUST be performed by experienced personnel fully acquainted with this equipment. Service done by inexperienced, unqualified personnel or the installation of unauthorized parts could cause personal injury, invalidate the warranty, or result in costly damage. Contact Respironics, Inc. or your health care dealer if the unit fails to meet performance specifications.

- To avoid electrical shock, disconnect the electrical supply before changing the fuses.

- For continued protection against risk of fire, replace fuses with those of the same type and rating only.

Cleaning

- To avoid electrical shock, unplug the BiPAP 30 unit before cleaning it.

1.2 Cautions

CAUTION: Federal law restricts this device to sale by or on the order of a physician.

- The BiPAP 30 DCP cable connector port is NOT a standard computer communications port — it provides analog outputs. Connecting the output port to a computer could damage the computer and the BiPAP 30 unit.

- On BiPAP S/T-D 30, all 15 output signal pin connections are active. Care must be exercised to prevent electrical shorting between the pin connections.

- The electronic components used in the BiPAP 30 are subject to damage by static electricity. Use the proper static discharge and grounding precautions when servicing this equipment. Service only at a static-free workstation.

- Only Respironics, Inc. cables should be used. Use of any other cable types may cause damage to the BiPAP 30 System.

- For pressure monitoring, use only tubing with a smooth inner lumen.

Cautions *continued*

- When transporting or storing the BiPAP 30 System, precautions should be taken to avoid exposure to temperature extremes. If exposure to such temperatures has occurred, the unit should be allowed to come to room temperature before being turned on.
- The unit should be positioned on its base or rear panel for proper operation.
- The voltage selector switch must be set according to local line voltage, and the proper fuses must be used.
- When using Respironics smooth inner lumen tubing without a heated humidifier, the overall length of the tubing should not exceed twelve feet.
- Regularly inspect the DCP 30 cable for frays, wire breaks, etc.
- Operational verification of medical monitoring equipment used near the BiPAP 30 System is recommended to assure that any electromagnetic interference produced by the system unit does not affect the function of the monitoring equipment.

1.3 Notes

- When in the S, S/T, or T modes, the Inspiratory Positive Airway Pressure (IPAP) and Expiratory Positive Airway Pressure (EPAP) controls are electrically coupled. The unit will not deliver an EPAP level that is higher than the set IPAP level. If the EPAP control is set higher than IPAP, the unit will be locked to the IPAP setting, and the IPAP Light Emitting Diode (LED) will remain lit.
- Circuit tubing with a smooth inner lumen and a nominal diameter of 22 mm is recommended. Tubing with a corrugated inner lumen will cause a pressure drop from the blower outlet to the patient connection. This may affect the unit's ability to deliver the maximum pressure.
- Heat and moisture exchangers should not be used with the BiPAP 30 System. Testing has shown that the ability of the unit to maintain the prescribed pressure is significantly affected by the addition of a heat and moisture exchanger to the patient circuit.
- Use of the Plateau Exhalation Valve may cause a Respironics Detachable Control Panel (DCP) to display Est V_T readings outside the stated DCP accuracy of ±15%. When the Plateau Exhalation Valve is used in a circuit, the DCP should not be used as the only basis for establishing tidal volume.
- Electromagnetic emissions: BiPAP 30 systems comply with CISPIR 11 - EN5501, Class B requirements.
- This manual serves as a reference. From time to time, minor changes may be made to the product that do not affect the use or intent of this manual.

Additional Warnings, Cautions, and Notes are located throughout this manual.

Chapter 2: System Description

2.1 BiPAP 30 System Specifications

FUNCTIONS:

IPAP	Delivers set pressure continuously.
EPAP	Delivers set pressure continuously.
Modes	Spontaneous Spontaneous/Timed Timed CPAP

PRESSURE AND FLOW CHARACTERISTICS

Pressure range for IPAP or EPAP	IPAP: 4 cm H_2O to 30 cm H_2O* at -60/+100 L/min flow EPAP: 4 cm H_2O to 30 cm H_2O* at -60/+100 L/min flow Pressure controls are electronically coupled so that the unit will not deliver a higher EPAP than IPAP level when the unit is operated in the S, S/T or T modes.
Pressure Calibration Accuracy	± 2 cm H_2O of the indicated control setting.
Pressure Setting Stability	± 1 cm H_2O over 8 hours.

NOTE: For specifications, all pressure measurements were made at the blower outlet unless stated otherwise.

*Measured at the end of a six-foot section of smooth inner lumen tubing.

CYCLING:

Breaths per Minute (BPM)	4 to 30
Breathing Rate Accuracy	±10% or 2 BPM of the indicated reading, whichever is greater.
%IPAP	10 to 90 %
%IPAP Setting Accuracy	±10% of the indicated setting
Minimum IPAP Time	Approximately 300 msec (S, S/T Modes only)
Maximum IPAP Time	3 seconds ±0.5 second at a constant flow rate of 100 L/min (S, S/T Modes only)
Minimum EPAP Time	Approximately 300 msec (S, S/T Modes only)

CIRCUIT:

Whisper Swivel Continuous Leak Rate

Pressure	Nominal Leak
5 cm H_2O	14 L/min
10 cm H_2O	21 L/min
15 cm H_2O	26 L/min
20 cm H_2O	30 L/min
25 cm H_2O	31 L/min
30 cm H_2O	34 L/min

ELECTRICAL:

Electrical Requirements	100 to 132 (60 Hz) or 200 to 253 (50 Hz) VAC Voltage range selected by a rear panel mounted selector switch.
Current Consumption	At 115 VAC: 1.4 A typical At 230 VAC: 0.7 A typical
Electromagnetic Emissions	Complies with CISPIR II—EN5501, Class B Requirements
Ground Continuity	Complies with ECRI, less than 500 mΩ Typical for BiPAP 30: 45 mΩ
Current Leakage	Complies with ECRI, less than 100μA Typical for BiPAP 30: 8.2 μA

PHYSICAL CHARACTERISTICS:

Dimensions	Approximately 7 3/4" x 9" x 15 1/4" (20 cm x 23 cm x 39 cm)—without accessory cap
Weight	17.6 lbs (8.0 Kg)
Operating Temperature	40 to 95 °F (10 to 35 °C)
Storage Temperature	-20 to 140 °F (-29 to 60 °C)
Outlet Temperature	25 °F maximum difference between room temperature at the air inlet and air temperature at the end of a six foot tubing with a smooth inner lumen. A typical temperature difference is 10 °F to 20 °F after an eight hour overnight use, with typical pressure settings of 12 cm H_2O IPAP and 5 cm H_2O EPAP. A difference of 18 °F is a "service may be desirable" guideline because patients may become concerned about warm air or about a warm unit.
Noise Level	No specification is given because various test instruments, test procedures, and unit operating conditions produce varying results.

2.2 Functional Description

The BiPAP 30 System
Models S/T 30 and S/T-D 30

The BiPAP 30 System is a positive pressure, electrically driven ventilation system with electronic pressure control. The unit's pressure controls are adjusted to deliver pressure support for patient ventilatory assistance.

The BiPAP 30 System is primarily intended to augment patient ventilation by supplying pressurized air through a patient circuit. It senses the patient's breathing effort by monitoring airflow in the patient circuit and adjusts its output to assist in inhalation or exhalation. This assistance is provided by the administration of two levels of positive pressure. During exhalation, pressure is variably positive or near ambient. The inspiratory level is variably positive and is always higher than the expiratory level.

The Respironics BiPAP 30 System responds to changes in patient flow rates that indicate movement to inhalation and exhalation. It performs reliably in sensing the patient's breathing efforts, even with the presence of most leaks in the patient circuit. Automatic adjustment of the trigger threshold in the presence of leaks is what makes the BiPAP 30 System ideal for mask-applied ventilation assistance.

The BiPAP 30 System senses air flow in the patient circuit by using a flow transducer in conjunction with the patient air outlet. The flow signal is composed of flow into the patient's lungs and flow due to leaks in the patient circuit. This flow data is continuously processed, and adjustments are automatically made to trigger thresholds. The adjustments provide high sensitivity to inspiratory effort and rapid adjustment for changing leaks while minimizing inspiratory pressure lockup or auto-triggering.

The BiPAP 30 System can operate in the following four modes. In each mode, the prescribed setting for each functional control must be determined by the physician/technician based on appropriate patient testing and monitoring of the necessary physiologic parameters.

SPONTANEOUS (S) MODE

The unit cycles between the Inspiratory Positive Airway Pressure (IPAP) and Expiratory Positive Airway Pressure (EPAP) levels in response to patient triggering. The patient determines the respiratory rate.

SPONTANEOUS/TIMED (S/T) MODE

The unit cycles between the IPAP and EPAP levels in response to patient triggering. If the patient fails to initiate an inspiration, the unit will cycle to IPAP based on a preset interval determined by the Breaths Per Minute (BPM) control.

TIMED (T) MODE

The unit cycles between the IPAP and EPAP levels based solely on the timing intervals as determined by the rate (BPM) and inspiratory time (% IPAP) controls. The patient cannot superimpose spontaneous respirations over the IPAP and EPAP levels.

CONTINUOUS POSITIVE AIRWAY PRESSURE (CPAP)

With the Function Selector Knob set in either the IPAP or EPAP position, the pressure set on the corresponding dial will be delivered continuously.

Additional Functions of the BiPAP S/T-D 30 System

An optional Detachable Control Panel (DCP) can be interfaced with the BiPAP 30 System diagnostic unit to provide remote adjustment of all the operating parameters. The DCP also provides a selectable display of IPAP, EPAP/CPAP, Estimated Exhaled Tidal Volume (V_{T_E}), and Estimated Leak.

In addition to the functions listed above, the BiPAP 30 System DCP 30 provides output signals that can be interfaced with a recorder or oscilloscope. The available signals are:

- Estimated Tidal Volume: V_T
- Estimated Patient Flow Rate: $\dot{V}_{est}$
- Total Flow Rate: $\dot{V}_{tot}$
- Pressure: P

2.3 System Components

Figure 2-1 shows the BiPAP 30 main system components; Figure 2-2 shows the BiPAP 30 air flow.

Blower Assembly

The blower draws air in through a replaceable filter, pressurizes it, and circulates it through the system.

Valve (Pressure Assembly)

The valve maintains a set pressure in the system by automatically adjusting to increase or decrease the amount of air vented from the valve chamber. Electronic circuitry controls whether the system pressure should be maintained at IPAP or EPAP level.

Flow Transducer (Flow Monitor)

The flow transducer senses changes in the system flow rate and transmits the data to the electronic circuitry.

Electronic Circuitry

The electronic circuitry analyzes the data sent by the flow transducer and sends signals to the pressure valve, causing it to cycle from the preset IPAP to the preset EPAP (or EPAP to IPAP) pressure levels.

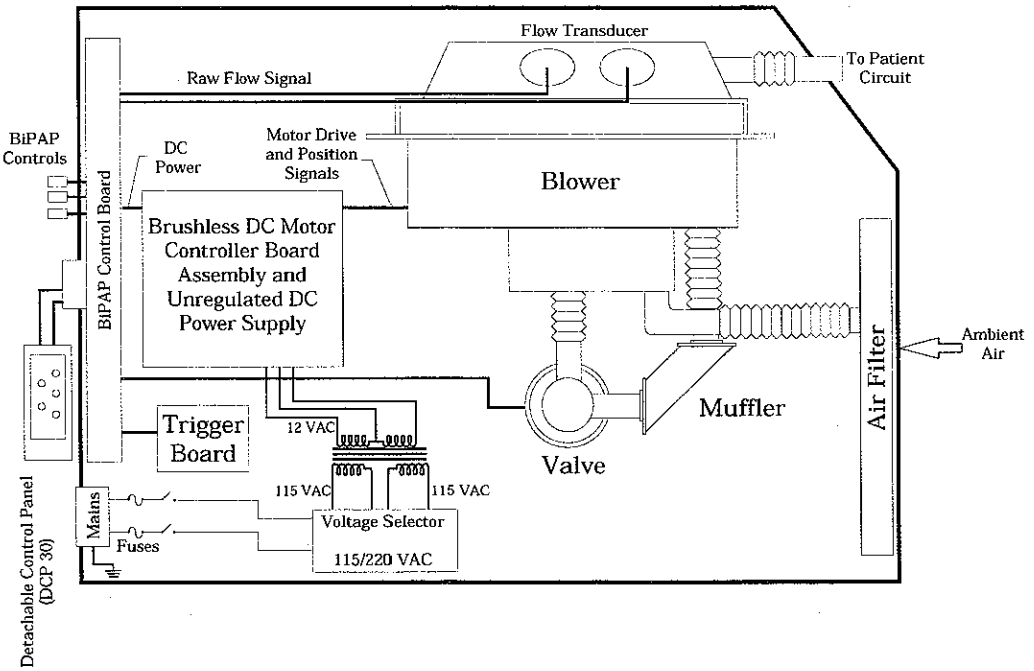


Figure 2-1.

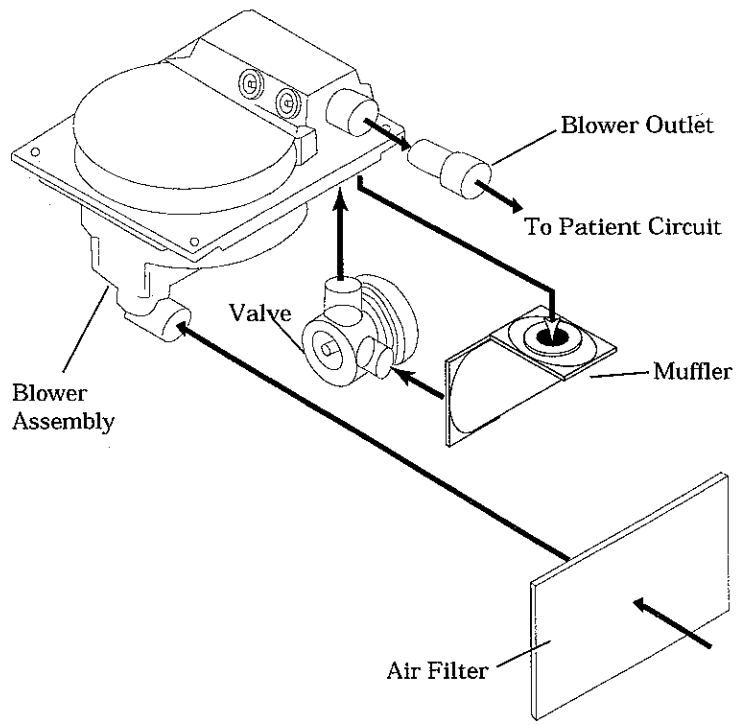


Figure 2-2.

2.4 Unit Identification

BiPAP 30 systems are identified by their Part Number, which is the number used to order the units. A serial number, located on the back lower right of the unit, further identifies an individual unit. The following model numbers identify the types of units manufactured at the time of printing.

Canadian

Part Number	Description
552045	S/T 30 Home System
552006	S/T-D 30 Canadian Clinical System
552048	S/T-D 30 Clinical System with DCP, CSA
552049	S/T-D 30 Canadian Hospital Core Package

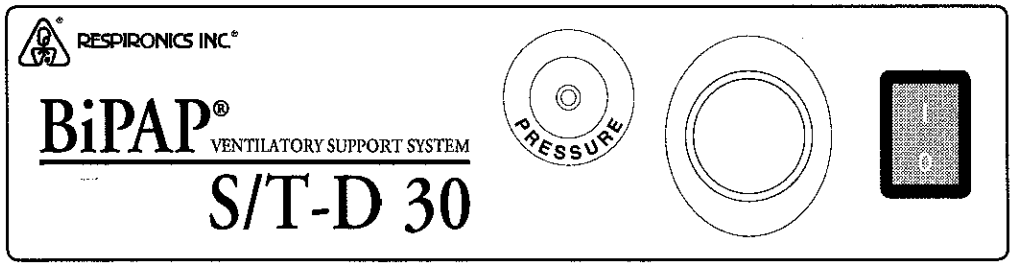
International

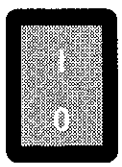
Part Number	Description
552042	S/T 30 International Home System
552047	S/T-D 30 International Clinical System
552052	S/T-D 30 International Hospital Core Package

Chapter 3: Controls and Setup

3.1 Description of Controls

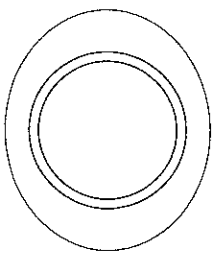
FRONT PANEL





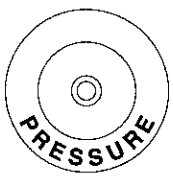
POWER SWITCH

Turns the electrical power to the BiPAP 30 unit on and off.



TUBING CONNECTOR

22 mm O.D. connector accepts Respironics smooth inner lumen tubing or a main flow bacteria filter.

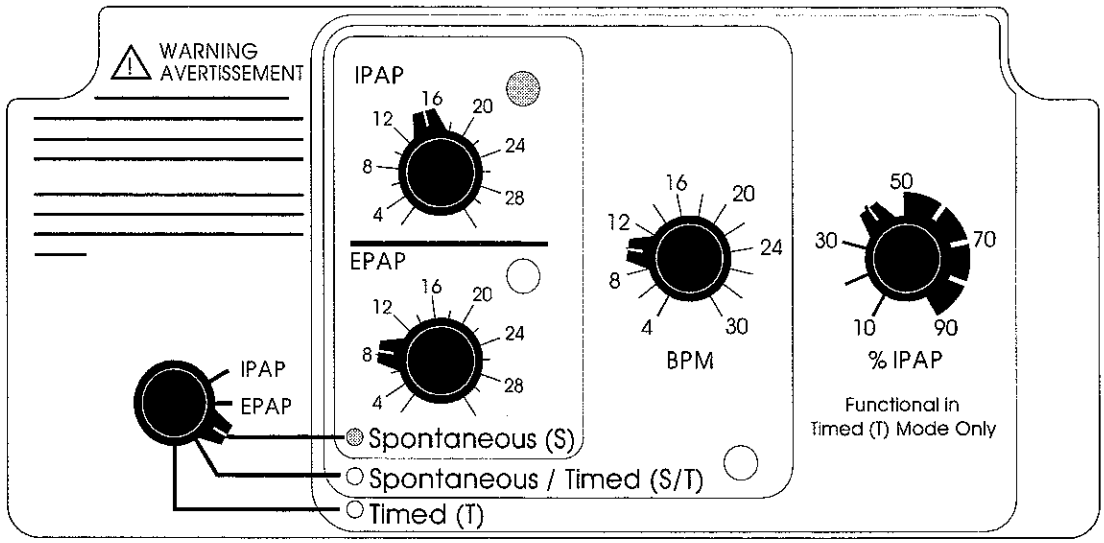


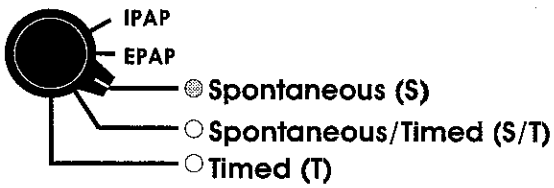
PRESSURE PORT

S/T-D 30 units only: Accepts manometer tubing with a smooth inner lumen. Interfaces with an internal pressure transducer to provide in-line pressure monitoring with output to a recorder. Source of the pressure display for the Detachable Control Panel (DCP). The range is 0 to 30 cm H_2O.

CAUTION: Never connect oxygen or any positive pressure source to this port.

CONTROL PANEL





FUNCTION SELECTOR KNOB

The position of the indicator on the knob determines which function or mode will be active. The Function Selector Knob has five discrete positions.

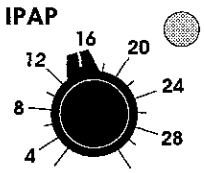
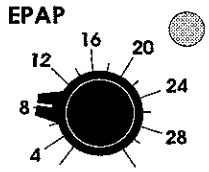
IPAP Position: Inspiratory Positive Airway Pressure. With the Function Selector Knob in this position, the unit delivers CPAP at the level indicated by the IPAP pressure control. The EPAP setting is not active.

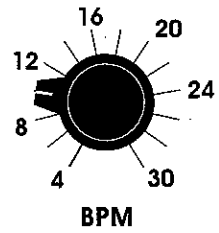
EPAP Position: Expiratory Positive Airway Pressure. With the Function Selector Knob in this position, the unit delivers CPAP at the level indicated by the EPAP pressure control. The IPAP setting is not active.

Spontaneous (S) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP and EPAP.

Spontaneous/Timed (S/T) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP, EPAP, and BPM.

Timed (T) Mode: When set at this mode, the adjacent LED is illuminated. Active controls are IPAP, EPAP, BPM, and % IPAP.

CONTROLS	
	**IPAP CONTROL** Inspiratory Positive Airway Pressure Active when the Function Selector Knob is in any of these four positions: IPAP, S, S/T, or T. When the BiPAP 30 unit is delivering IPAP, the adjacent LED is illuminated. Range = 4 to 30 cm H_2O.
	**EPAP CONTROL** Expiratory Positive Airway Pressure Active when the Function Selector Knob is in any of these four positions: EPAP, S, S/T, or T. When the BiPAP 30 unit is delivering EPAP, the adjacent LED is illuminated. Range = 4 to 30 cm H_2O. **NOTE:** The IPAP and EPAP controls are electrically coupled. The unit will not deliver a higher EPAP than IPAP level. If the EPAP control is set higher than the IPAP control, the BiPAP 30 unit will be locked to the IPAP setting, and the IPAP LED will remain lit. This is active throughout the S, S/T, and T settings on the Function Selector Knob.

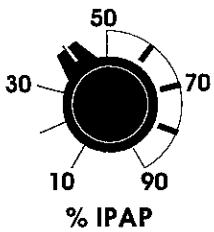


BPM CONTROL

Breaths Per Minute: Active when the Function Selector Knob is positioned in either the S/T or the T mode. Range = 4 to 30 BPM.

S/T Mode—The BPM control sets a time interval for delivery of a breath by the BiPAP 30 System. If the patient initiates a spontaneous breath, the BPM timer is reset. If the patient does not initiate a spontaneous IPAP trigger within the interval set by the BPM control, the unit will initiate a timer triggered breath. The BPM timer is reset with each transition from EPAP to IPAP whether the transition was triggered by the patient or by the BPM control setting. The adjacent LED will illuminate, indicating timer-initiated IPAP transitions.

T Mode—All triggering from EPAP to IPAP is controlled by the BPM timer. The BPM LED is not active. The % IPAP control must also be set.

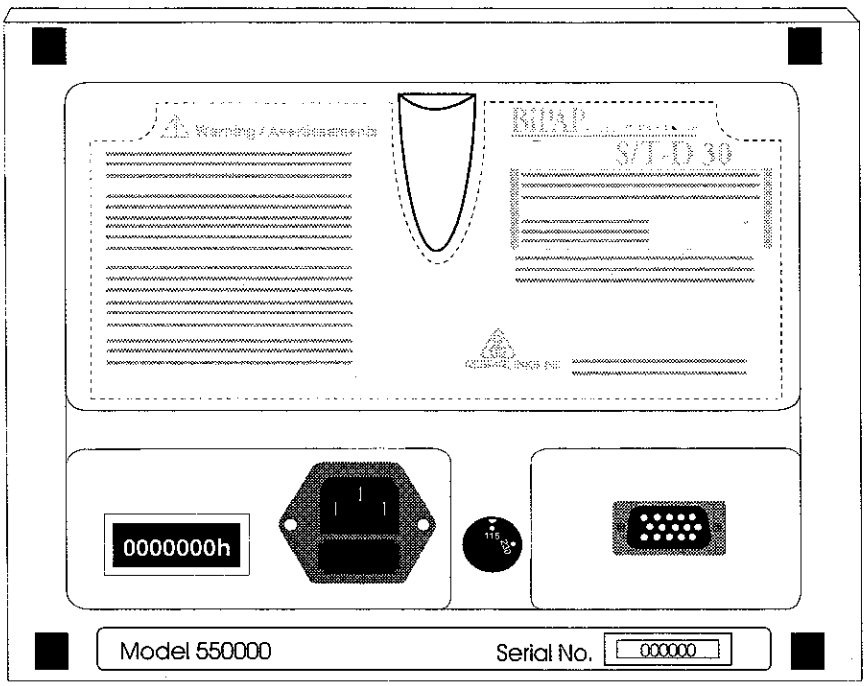


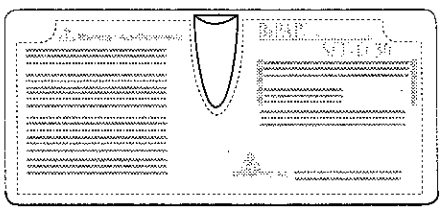
% IPAP CONTROL

Active when the Function Selector Knob is positioned in the T mode only. This control works in conjunction with the BPM control and determines the fraction of the respiratory cycle spent in IPAP. The range is 10 to 90%

NOTE: For % IPAP values greater than 50%, time spent at IPAP will exceed the time spent at EPAP (i.e., an inverse I:E ratio will be delivered).

REAR PANEL





CONTROL PANEL DOOR

Contains the warnings, cautions, and electrical information necessary for safe operation of the BiPAP 30 System.

VOLTAGE SELECTOR SWITCH

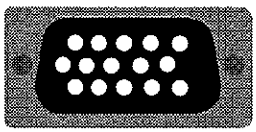
Set this switch to the appropriate line voltage.

Canada—115 Volts

European and other countries—Check the country's line voltage requirements for the correct setting.

TIME METER

Provides resolution to 1/10 hour. Runs only when the ON/OFF switch is turned ON (I).

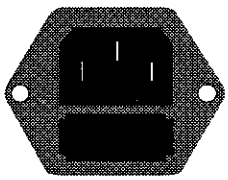


DCP CABLE CONNECTOR

S/T-D 30 units only: DB15 female connector interfaces to an optional Detachable Control Panel (DCP) that duplicates the BiPAP S/T-D 30 System control panel. Refer to the DCP Section of the clinical manual for complete operating information.

CAUTION: The DCP Connector is NOT a standard computer communications port. Attaching the connector to a computer could damage the computer and the BiPAP 30 unit.

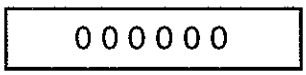
This connector is not compatible with BiPAP 20 DCP cables.



AC INLET CONNECTOR

Electrical input for the power cord. Use only a Respironics, Inc. approved cord set with appropriate grounding.

Holds two 2 A, 5 mm X 20 mm fuses. The BiPAP 30 System uses the same 2A fuses for both 115 V and 230 V operation. A combination of these inlet fuses and internal transformer fuses are used to provide proper fusing.



SERIAL NUMBER LABEL

The information on the serial number label should be recorded on the BiPAP 30 Warranty Card and returned to Respironics within 10 days of purchase.

3.2 BiPAP 30 System Configuration

Figure 3-1 illustrates the BiPAP 30 hospital system configuration.

NOTE: This information is provided for service personnel reference and is not intended to be used for system set-up or use. System set-up should be performed by appropriately trained personnel using the BiPAP 30 System Clinical Manual as a guideline.

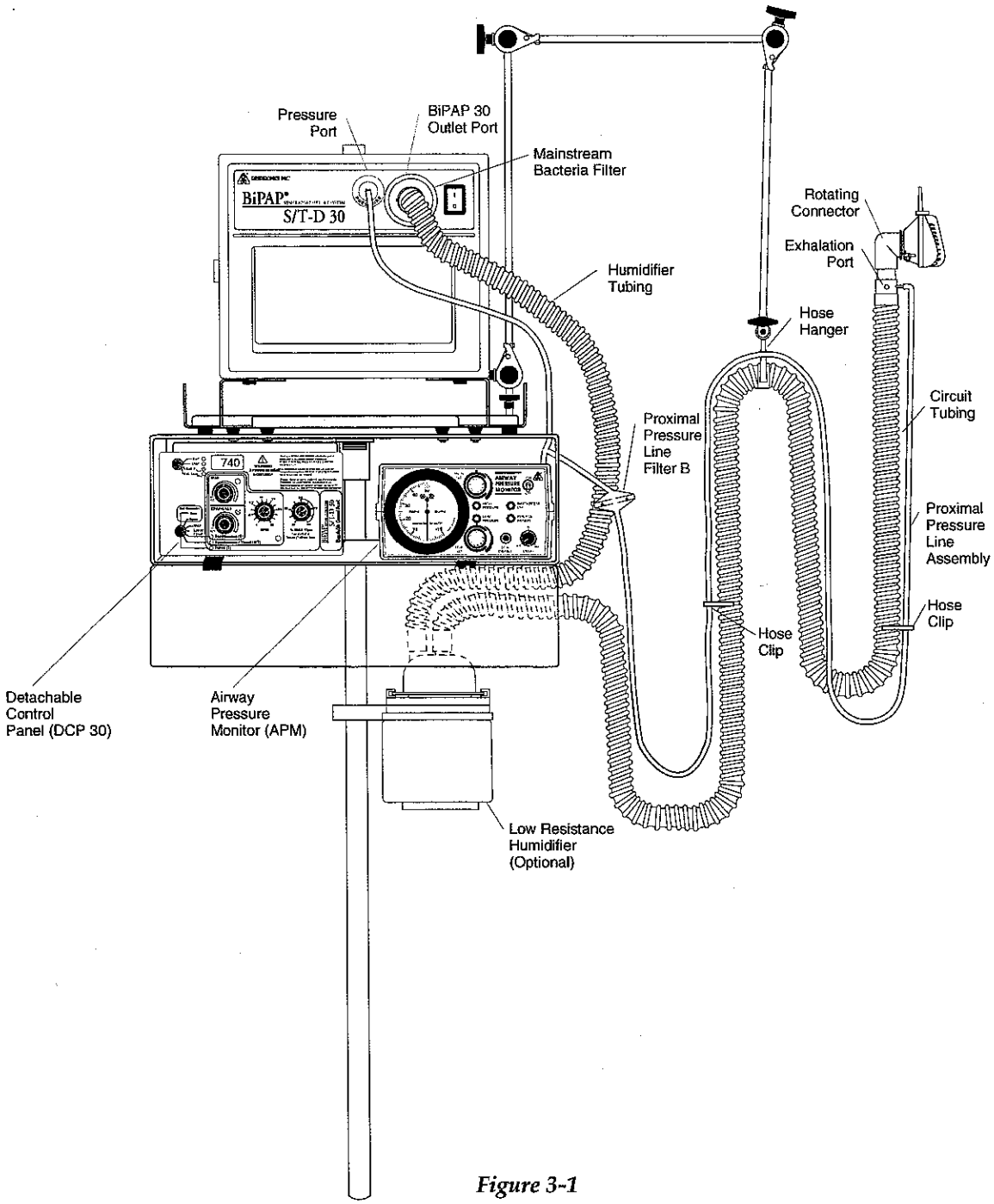


Figure 3-1

Chapter 4: Maintenance

4.1 Maintenance Schedule

The Maintenance Schedule on page 4-2 lists the items that must be periodically inspected or replaced. Use the Log to record the dates you perform the maintenance items. You may photocopy the Maintenance Log for each unit you service.

Appendix B contains a copy of the Maintenance Schedule without the Service Manual page format.

RESPIRONICS INC.®

BiPAP 30 Preventive Maintenance Schedule

(Factory Recommended)

Patient _____ Servicing Agent _____

Address _____ Address _____

_____ _____

Phone _____ Phone _____

Model _____ Serial# _____ Date Purchased _____

Refer to Section 4.2 of this manual for maintenance and service instructions.

Maintenance Item	Service Interval	Date				
Record hours on meter. See 4.2.1.	Annually, or when service performed.					
Verify voltage selector switch. See 4.2.2	Annually					
Inspect fuses. See 4.2.3	Annually					
Test unit control functions. See 4.2.4	Annually					

4.2 Maintenance Procedures

4.2.1 Recording the Hours on the Time Meter

See Section 3.1 for the location and description of the Time Meter.

4.2.2 Verifying the Voltage Selector Switch Setting

See Section 3.1 for the location and description of the Voltage Selector Switch.

4.2.3 Changing the Fuses

Inspect the fuses yearly. Verify the fuse values .

The fuses are located in the back of the unit under the electrical cord connector. Refer to Chapter 8 for fuse part number and reordering information.

WARNING: To avoid electrical shock, disconnect the electrical supply before changing the fuses.

To change blown fuses:

Step 1 Remove the fuse holder by pushing in on the small tabs on the sides of the holder as shown in Figure 4-4.

Step 2 Pull the fuse holder completely out of the unit as shown in Figure 4-5.

Step 3 Replace the old fuses with new fuses of the same type and rating.

Step 4 Insert the fuse holder back into the unit as shown in Figure 4-5.

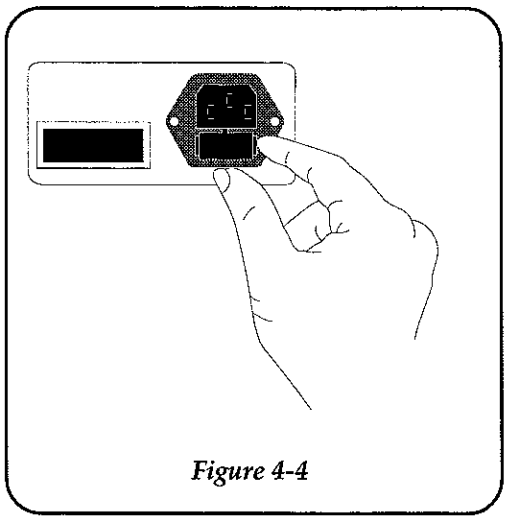


Figure 4-4

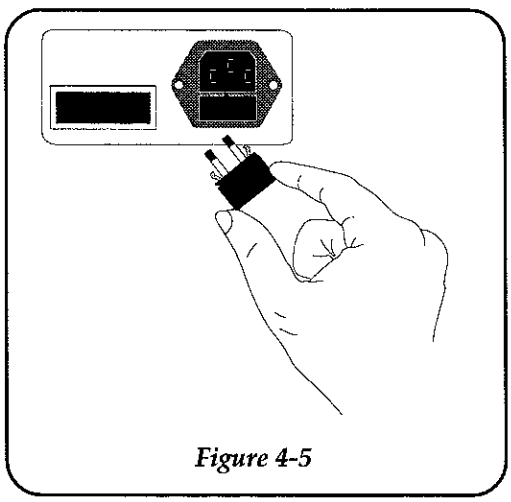


Figure 4-5

4.2.4 Test Control Functions

As a minimum test, perform the BiPAP 30 System Screening Procedure in Appendix C. As a more rigorous test, you may choose to perform the System Test in Chapter 7. Perform only the Final Test, in which only measurements are taken and no adjustments are made.

4.2.5 Notes to Maintenance Procedures

Sections 4.2.1 to 4.2.4 are preventive maintenance procedures for the BiPAP 30 unit only. There are user care activities that the user or caregiver may do but are not specifically required as part of the preventive maintenance schedule. For more information, see the BiPAP 30 User Guide. These activities include:

- Cleaning the exterior of the unit when visibly dirty. See Section 4.2.6 of this manual.
- Replacing the disposable filter every 30 days of use, or when visibly dirty. See Section 4.2.7 of this manual.
- The mask, tubing, and exhalation port are accessories. They should be cleaned and inspected daily according to their individual instruction sheets.
- The Softcap®, chin strap, and headgear are also accessories. They should be cleaned and inspected weekly according to their individual instruction sheets.

For more information about these accessories, refer to the individual instruction sheets or to the User Circuit Accessories Guide.

4.2.6 Cleaning the BiPAP 30 Unit

CAUTION: Do not clean any parts of the system with alcohol or cleaning solutions containing alcohol. These cleaning processes may harden or deform the flexible plastic parts of the system and adversely affect their function. Do not clean the system by steam autoclave or gas sterilization methods.

CAUTION: Unplug the BiPAP 30 before cleaning it. Do not immerse it in water or allow any liquid to enter the cabinet. Do not get the filter wet.

Step 1 Using a cloth slightly dampened with water and a mild dish detergent or standard hospital-grade disinfectant, wipe the outside of the BiPAP 30 enclosure.

Step 2 Let the BiPAP 30 dry before plugging it in again.

4.2.7 Changing the Filter

CAUTION: Failure to replace a dirty filter may cause increased operating temperatures in the BiPAP 30 unit, may reduce the flow, and may reduce the output pressure.

The white filter on the front of the BiPAP 30 is disposable and should be replaced after thirty days of use or sooner if it is especially dirty. One extra filter is included with the clinical system.

Step 1 Turn the BiPAP 30 unit OFF (0) and unplug the electrical cord from the wall outlet and from the back of the unit.

Step 2 See Figure 4-1. Press down (1) and pull out (2) on the top of the Whisper Cap. You need to press down only about $^1/_8$" to allow the top lip of the Whisper Cap to clear the filter retainer.

Step 3 Pull up (3) on the bottom of the Whisper Cap until the bottom lip clears the filter retainer.

Step 4 See Figure 4-2. Locate the button in the center of the filter holder beneath the surface of the filter. Push in on the button and pull the filter out from all four sides of the filter holder.

Step 5 Throw away the dirty filter. The filter is not washable.

Step 6 Center a new filter over the filter holder. Carefully push in on the center button and tuck the filter in on all four sides as shown in Figure 4-3.

Step 7 Release the button. The filter should be intact and fit securely, covering the entire holder. Remove and readjust the filter if necessary.

Step 8 Insert the bottom lip of the Whisper Cap behind the inner bottom edge of the filter retainer.

Step 9 Simultaneously press down on the top of the Whisper Cap and push in until the top lip of the Whisper Cap snaps into place behind the inner top edge of the filter retainer.

The filter should be in place at all times when the BiPAP 30 unit is being used. A clean filter protects the patient from breathing irritating airborne particles.

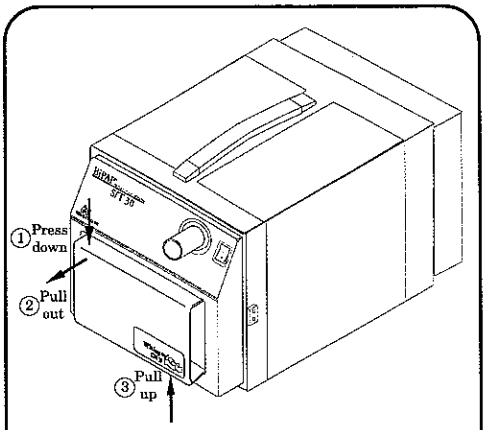


Figure 4-1

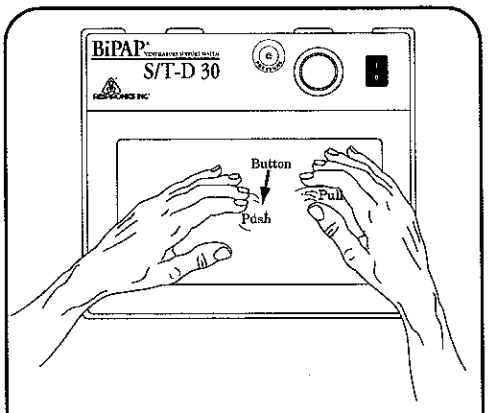


Figure 4-2

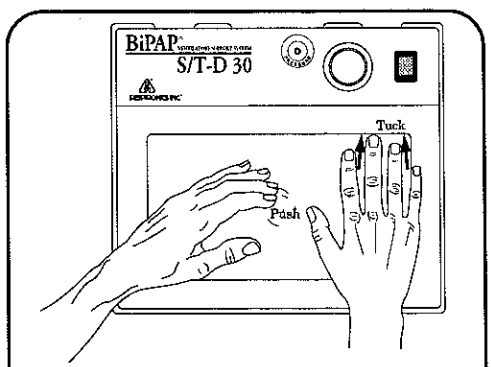


Figure 4-3

Chapter 5: Troubleshooting

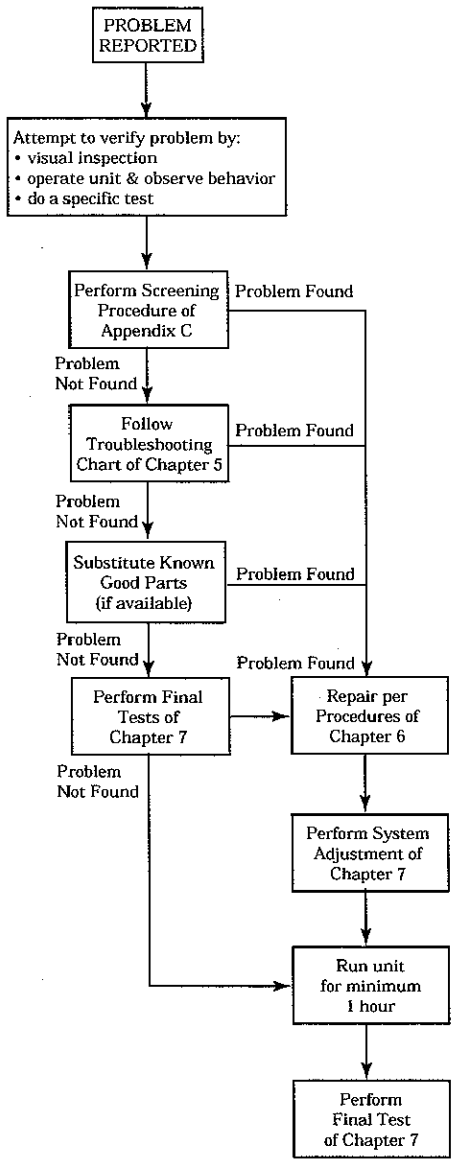
5.1 Troubleshooting

WARNING: Electrical Shock Hazard: Disconnect the electrical supply before repairing the unit.

CAUTION: Electronic components used in this unit are subject to damage by static electricity. Use proper static discharge equipment and grounding precautions when servicing the equipment. Service only at a static-free workstation.

This section describes some unit problems that might occur, the possible causes, and the corrective actions that can be taken.

The general repair procedure is as follows:


PROBLEM REPORTED
Attempt to verify problem by:
• visual inspection
• operate unit & observe behavior
• do a specific test
Perform Screening Procedure of Appendix C
Problem Found
Problem Not Found
Follow Troubleshooting Chart of Chapter 5
Problem Found
Problem Not Found
Substitute Known Good Parts (if available)
Problem Found
Problem Not Found
Problem Found
Perform Final Tests of Chapter 7
Repair per Procedures of Chapter 6
Problem Not Found
Perform System Adjustment of Chapter 7
Run unit for minimum 1 hour
Perform Final Test of Chapter 7

5.1.1 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
The unit does not turn on.	The power cord is not securely attached to the unit or wall outlet.	Check that the power cord is plugged into the unit and into the wall outlet.
	The unit is not connected to a live outlet.	Check that the wall outlet has power. Check the circuit breaker.
	The unit fuse(s) is blown.	Replace fuse(s). See Section 4.2.3. If new fuses continue to blow out, follow Procedure 5.1.4 then Procedure 5.1.5 if necessary.
	Main power switch malfunction.	Remove the power cord from the wall outlet and the unit. With an ohmmeter, check between the top and bottom connections on each side of the switch. When the switch is "OFF," the connections should be open. When the switch is "ON," the connections should be closed (0 Ω).
	The fuse drawer is damaged or installed incorrectly.	Remove the fuse drawer from the AC Inlet. See Section 4.2.3. Inspect the drawer for damaged springs.
	The voltage selector switch is set to wrong voltage.	Verify the proper setting of the voltage selector switch on the back of the unit. If the unit is set at 230 V but plugged into a 115 V line, the unit will not operate. If the unit is set at 115 V but plugged into a 230 V line, the unit may operate intermittently.
	The transformer secondary fuses are blown.	Follow Procedure 5.1.4.
	The motor wire is not securely plugged into the J1 position on the motor control board.	Check that the terminal is oriented properly and securely fastened to the board pins.
	Transformer malfunction.	Follow Procedure 5.1.4.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
The unit does not turn on. (Continued)	Faulty jumper wires on the primary side of the transformer.	Check the continuity of the jumper wires between transformer terminals T1-T3 and between T4-T5. Replace the jumpers if necessary.
	Faulty wiring; overcrimped or broken terminals.	Follow Procedure 5.1.2.
	Motor control board (MCB) malfunction.	Follow Procedure 5.1.3.
The unit starts and stops.	Loose power cord connection at the unit or the wall outlet.	Check that the power cord connections (at the unit and at the wall) are firmly in place.
	Intermittent connection at the power switch or internal wiring.	Follow Procedure 5.1.2.
	Blower malfunction.	Replace the blower assembly. See Section 6.2.5.
	The voltage selector switch is set to wrong voltage.	Verify the proper setting of the voltage selector switch on the back of the unit. If the unit is set at 230 V but plugged into a 115 V line, the unit will not operate. If the unit is set at 115 V but plugged into a 230 V line, the unit may operate intermittently.
Incorrect pressure when checked with a water column or digital manometer. **NOTE:** Pressure readings may deviate ±2 cm H_2O from specified levels.	Blower malfunction.	If the blower displays any vibration or rumbling noise, replace the blower assembly. See Section 6.2.5.
	Motor control board (MCB) malfunction.	Follow Procedure 5.1.3.
	A leak in the system.	Visually inspect the flex connector, bellows, and pressure tubing for cracks or splits. Inspect the hose clamps and nylon tie wraps. Inspect the bellows or tubing under the clamps. Check that all fittings are tight and that the mask is not leaking.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Incorrect pressure when checked with a water column or digital manometer. (Continued)	The blower or the pressure controller is malfunctioning.	Perform the calibration (see Chapter 7) without making any adjustments to the trimpots, and record the data. Compare the test data with the specifications; if the unit does not meet the specs, perform the full calibration and readjust the trimpots where needed. If the unit fails, then replace the part indicated by the test.
No difference between IPAP and EPAP pressures. **NOTE:** Pressure readings may deviate ±2 cm H_2O from specified levels.	Improper control settings.	Adjust the control settings. Recheck with a manometer.
	Valve disconnected.	Reconnect valve.
	Valve malfunction.	Follow Procedure 5.1.5.
	Blown crowbar fuse on BiPAP 30 Control Board.	Remove the fuse and check the continuity. Replace fuse if necessary.
	BiPAP 30 Control Board malfunction.	Follow Procedure 5.1.6.
Pressure fluctuations during IPAP or EPAP modes.	Blower assembly malfunction.	Follow Procedure 5.1.7.
	Motor control board malfunction.	Follow Procedure 5.1.3.
	Defective BiPAP 30 Control Board.	Perform the calibration (see Chapter 7). If the unit cannot be adjusted to meet specs, replace the control board.
Low flow and/or pressure.	Valve disconnected.	Reconnect valve.
	Blown crowbar fuse on BiPAP 30 Control Board.	Remove the fuse and check the continuity. Replace fuse if necessary.
	Valve malfunction.	Follow Procedure 5.1.5.
	BCB malfunction.	Follow Procedure 5.1.6.
	Blower assembly malfunction.	Follow Procedure 5.1.7.
	Filter dirty or clogged.	Replace the intake filter. See Section 4.2.7.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low flow and/or pressure. (Continued)	Leak in system.	Visually inspect the flex connector, bellows, and pressure tubing for cracks or splits. Inspect the hose clamps and nylon tie wraps. Inspect the bellows or tubing under the clamps. Check that all fittings, both internal and external, are tight and that the mask is not leaking.
Unit operates "warm."	The filter has become obstructed or dirty.	Replace the filter. See Section 4.2.5.
	Blower malfunction.	Check the motor for noise that indicates out of balance. If it is out of balance, replace the blower assembly as described in Section 6.2.5.
	Motor control board malfunction.	Follow Procedure 5.1.3.
Excessive noise or chattering.	Loose wraparound fit.	Replace the wraparound. See Section 6.2.2.
	The unit is operating without a filter—the plenum rattles.	Install a filter. See Section 4.2.5.
	The wiring harness vibrates against the blower assembly.	Manipulate the wiring assembly away from the blower assembly.
	The blower assembly is damaged.	Replace the blower assembly. See Section 6.2.5.
	The blower pressure is excessively high.	Perform the Final Test (see Chapter 7) without making any adjustments to the trimpots; record the data. Compare the test data with the specifications. If the unit does not meet the specs, perform the System Adjustment Test and readjust the motor speed as needed.
	Whisper Cap is missing.	Replace Whisper Cap.

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
The time meter is not functioning.	BiPAP 30 control board malfunction.	Measure the voltage at the BiPAP 30 control board connector J5, between pins 1 and 2 , with pin 1 as negative. The voltage should be +5 VDC ±0.5 V. If no voltage is measured, replace the BiPAP 30 control board. See Section 6.2.10.
	Time meter malfunction.	Measure the voltage between J5-1 and J5-2 as described above. If 5 VDC ±0.5 V is measured, replace the time meter. See Section 6.2.11.
The unit "breathes" on its own. IPAP/EPAP lights flicker erratically.	The pressure transducer tubing is disconnected.	Check the integrity of the tubing from the flow transducer to the BiPAP 30 Control Board. Reconnect the tubing if necessary.
	The tubing is routed incorrectly.	Check the routing of the tubing from the flow transducer to the BiPAP 30 Control Board for proper orientation.
The DCP does not work with the unit.	BiPAP is out of adjustment.	Perform System Final Test; see Chapter 7.
	DCP malfunction.	Replace the DCP unit.
	DCP cable malfunction.	Perform a continuity check on the cable or substitute with a known good cable.
Unit does not trigger in Spontaneous Mode.	BiPAP 30 Control Board (BCB) malfunction.	Check the DCP terminals. Replace the control board. See Section 6.2.10.
Unit does not trigger in S/T Mode.	Trigger board malfunction.	Change the trigger board. See Section 6.2.15.
	BCB malfunction.	Change BCB. See Section 6.2.10.

5.1.2 Power Switch Wiring

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wraparound (see 6.2.1).

Step 2 Check the continuity of the wires from the switch to the primary side of the transformer. The top white wire on the switch is connected to transformer terminal T3. The top red wire on the switch is connected to transformer terminal T4.

If either wire shows an open circuit, it may indicate a more serious problem. Return the unit to Respironics.

5.1.3 Motor Control Board (MCB) Checks

NOTE: The following voltage measurements were made on a new unit set to the IPAP mode. The outlet circuit consisted of the hose with a 0.25 inch orifice on the outlet end. The pressure was set to 10 cm H_2O, measured with a digital manometer. The input voltage was 110 VAC.

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wraparound (see 6.2.1).

Step 2 See Figure 5-1 for test points. Connect a DC voltmeter negative lead to TP4 (ground). Connect the positive lead to the cathode of CR12. Reconnect the power cord and turn the unit on; the voltmeter should read +15 to +22 VDC.

Step 3 Place the negative lead on TP4 (ground). Reconnect the power cord and turn the unit on. The following voltages should be present with respect to ground:

TP5:	35 to 45 VDC
TP3:	11 to 13 VDC
TP6:	-11 to -18 VDC

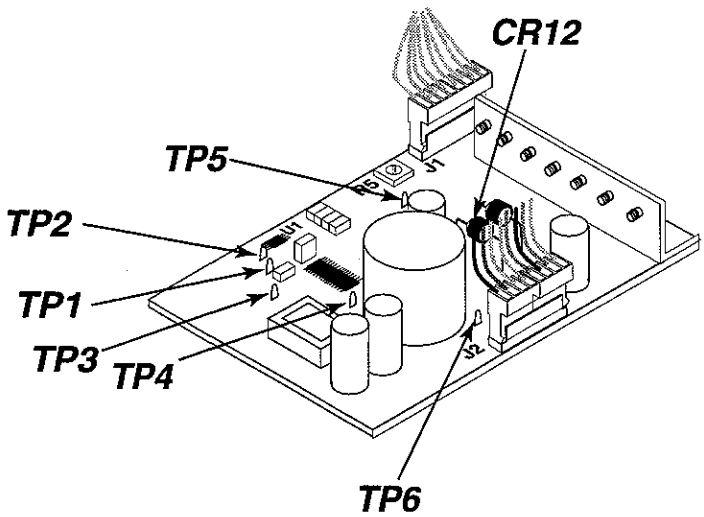


Figure 5-1

5.1.4 Transformer Checks

Step 1 Turn the unit off. Disconnect the power cord from the AC outlet and the unit.

Step 2 Remove the wraparound as shown in Section 6.2.1, Steps 1 to 5.

Step 3 Remove the bottom plate and position the plate to measure AC voltages on transformer connector J2. See Figure 5-2.

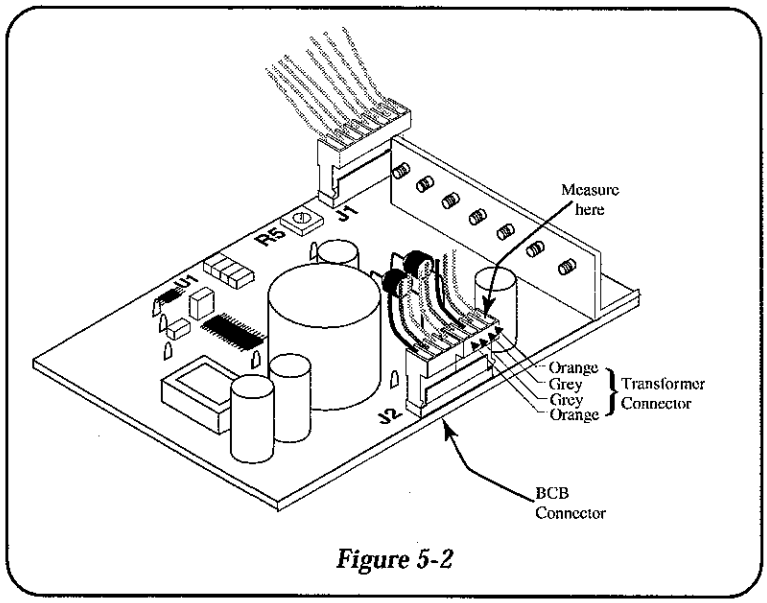


Figure 5-2

Step 4 Reconnect the AC power cord and turn the unit on.

Step 5 Measure the AC voltage across both orange-grey pairs. The voltage should be approximately 19.4 VAC. Measure the AC voltage across the orange pair. The voltage should be approximately 38.8 VAC. The presence of voltage at transformer connector J2 verifies that the transformer and transformer fuses are functional. Follow Section 5.1.3 to check the MCB.

Step 6 If there is no voltage at transformer connector J2, turn the unit off, disconnect transformer connector J2, and turn the unit back on.

Step 7 See Figure 5-3. Turn the unit upside down and check the voltages on the transformer secondary. In the figure, the transformer connectors have been removed for clarity. You should measure the following voltages:

From 1 to 2:	19.4 VAC
From 5 to 6:	19.4 VAC
From 1 to 6:	38.8 VAC

NOTE: If you see 19.4 VAC, from 1 to 6, then one of the two secondary fuses is probably open.

If 19.4 VAC ±15% is not measured from either 1 to 2 or 5 to 6, then replace the secondary fuses as described in Section 6.2.18.

NOTE: The value and tolerance of the above voltages is dependent on the value and tolerance of the supply-line voltage.

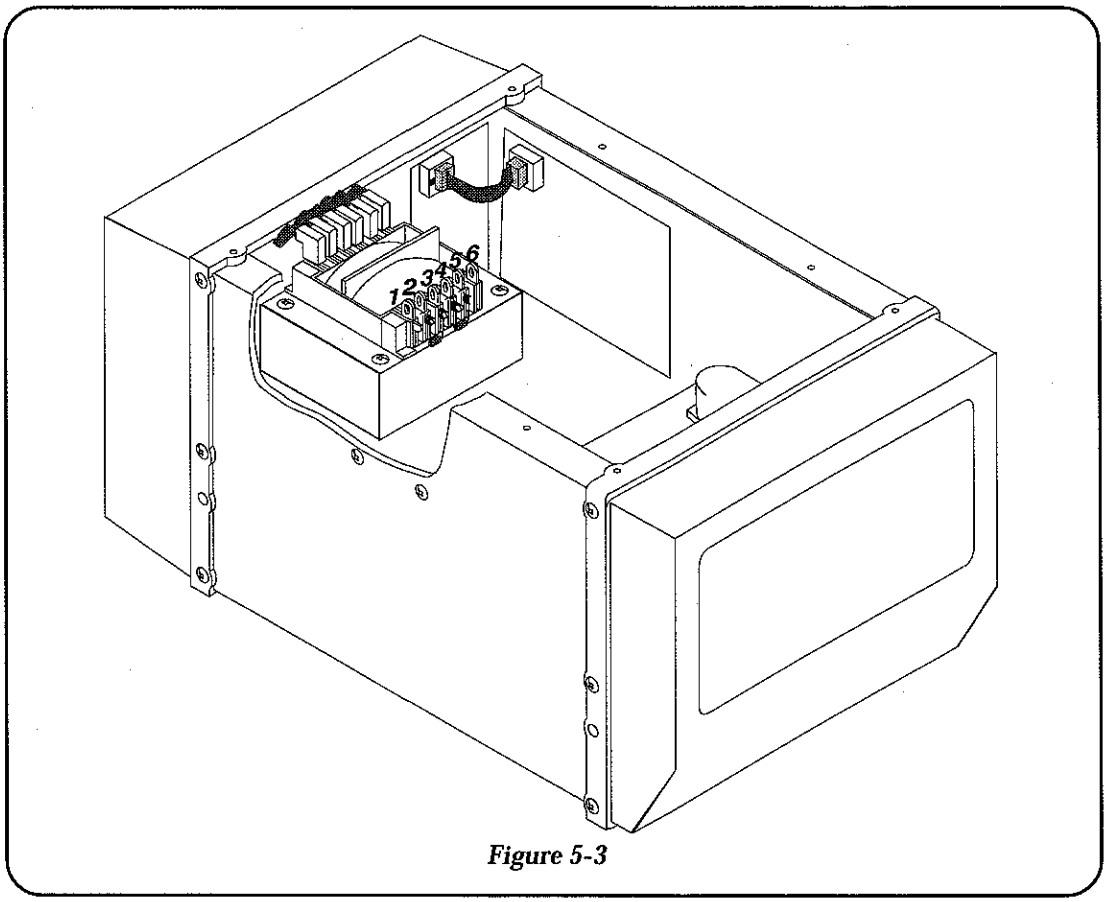


Figure 5-3

5.1.5 Valve Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around (see 6.2.1).

Step 2 Check the integrity and orientation of the J1 connector on the BiPAP 30 BCB.

Step 3 Connect a DC voltmeter from J1-1 (ground) to J1-2.

Step 4 Reconnect the power cord and turn the unit on.

If the voltmeter measures 0.0 VDC, replace the valve. See 6.2.8.

5.1.6 BiPAP 30 Control Board (BCB) Checks

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around as described in 6.2.1.

Step 2 Check the integrity and orientation of the J1 connector on the BCB.

Step 3 Connect a DC voltmeter from J1-1 (ground) to J1-2.

Step 4 Reconnect the power cord and turn the unit on.

If the voltmeter measures greater than 5.0 VDC, replace the BCB. See 6.2.10.

5.1.7 Blower Pressure Check

Step 1 Turn the unit off, disconnect the power cord from the wall and the unit, and remove the wrap-around as described in 6.2.1.

Step 2 Reconnect the power cord to the unit and the wall. Monitor the pressure at the outlet with a manometer.

Step 3 Turn the unit on and hold the valve shut. If the outlet pressure is not steady, replace the blower assembly as described in 6.2.5.

5.2 Wiring Diagram

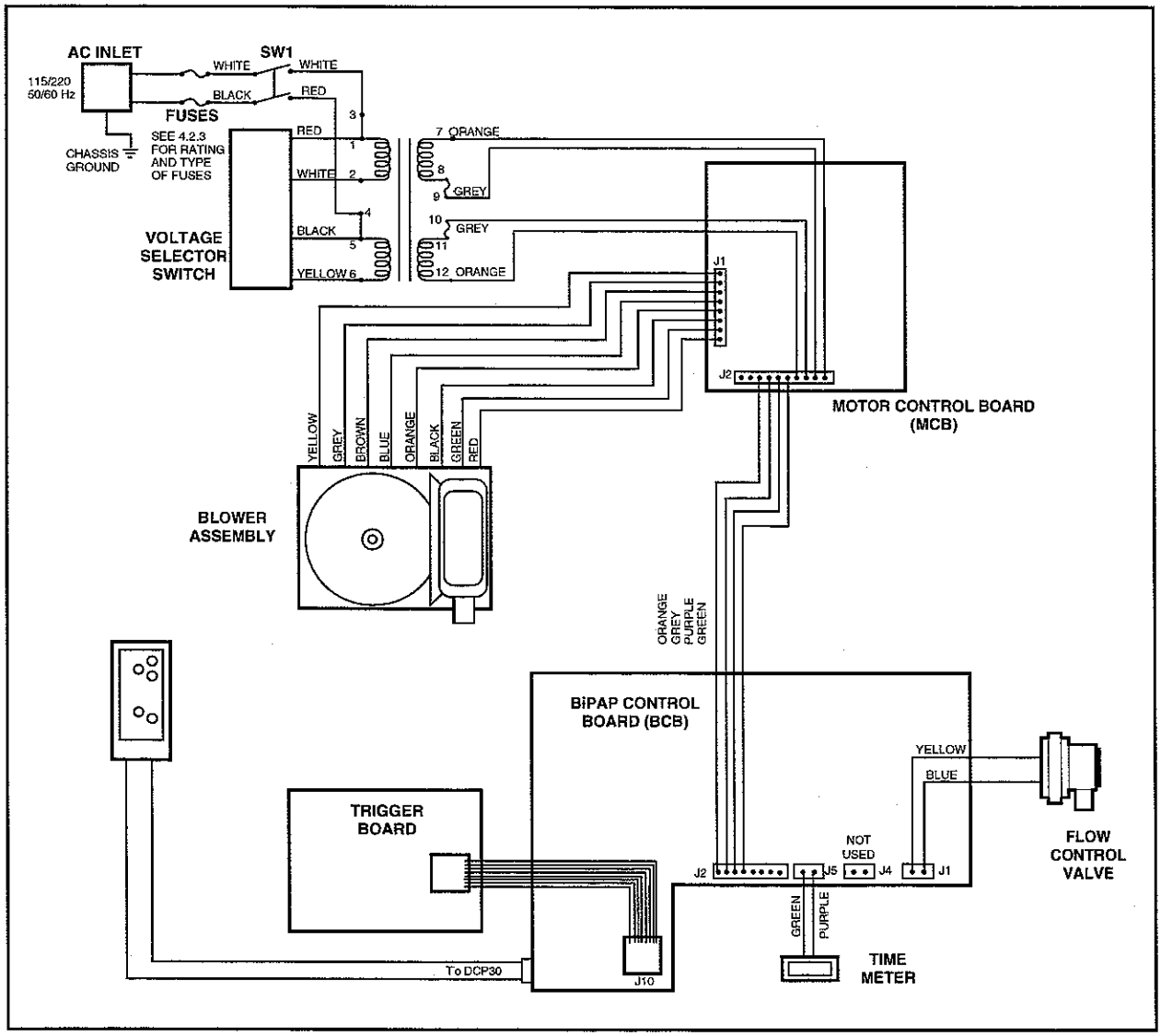


Figure 5-4

NOTE: Do not connect the DCP port to any other type of electronic equipment, computer interface, etc. Damage to the system may result.